

Abstract

Co-ordinated VSOP and Chandra Observations of 0836+710

Murphy D.W., JPL

In this paper we describe the radio observations that form part of co-ordinated Chandra, HALCA+VLBA, and VLBA-only observations of the high redshift ($z=2.17$) superluminal gamma-ray loud quasar 0836+710. The radio observations were at 6 frequencies (1.6, 5, 8, 15, 22, and 43 GHz) with the two lower frequency observations being undertaken with the VLBA co-observing with the HALCA spacecraft (which is the space element of the Japanese VSOP mission). The aim of the radio observations is to determine the peak brightness temperature for each of the VLBI radio components and hence provide better constraints on predicted X-ray emission than has previously been possible from radio data. Combining the radio data with the X-ray data enables the nature of this gamma-ray loud AGN to be further elucidated.

Part of this work has been undertaken at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

Coordinated VSOP and Chandra Observations of 0836+710

David W. Murphy, JPL

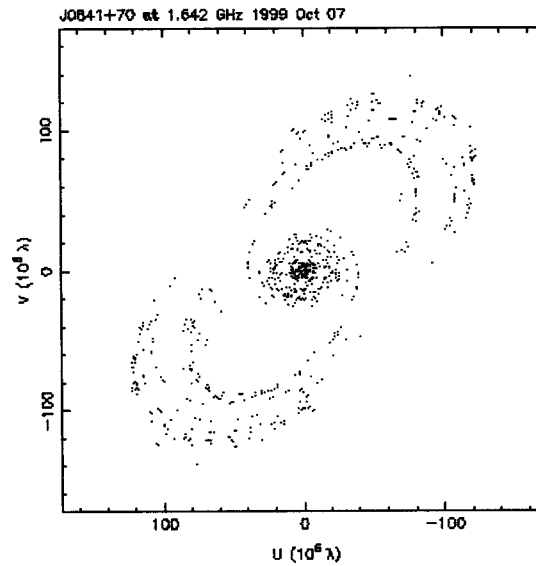
Source Selection

- PKS 0637-752 showed benefits of coordinated observations
- Compare Chandra and VSOP source lists: 74 'matches'
- 7 EGRET sources: 0235+164, 0836+710, Mrk 421, 1156+295, 3C273, 2155-304, and BL Lac
- Mrk 421, 2155-304 synchrotron not IC X-ray emission
- Good VSOP AO3 observations for: 0836+710, 3C273, 1156+295
- Chandra and VSOP observations:
 - 0836+710: 16-Oct-99, 7-Oct-99
 - 3C273: 9-Jan-00, TBD
 - 1156+295: TBD, TBD

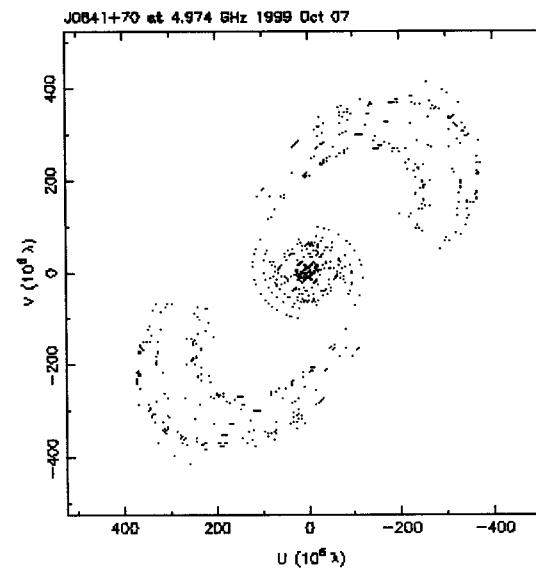
0836+710: VSOP+VLBA Observations

- Target of opportunity proposal
- Observation date: 7-Oct-99
- 06:00--17:00 (11 hours)
 - 2 VSOP orbits
 - HALCA: 1.6 GHz and 5 GHz, LCP only
 - VLBA: switching: 1.6 GHz or 5 GHz, LCP+RCP
- 17:00-20:00 (3 hours)
 - 15, 22, and 43 GHz VLBA snapshots

1.6 and 5 GHz HALCA+VLBA UV-coverages



1.6 GHz

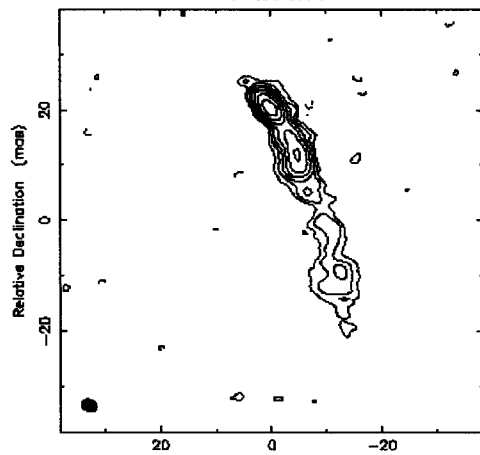


5 GHz

1.6 and 5 GHz HALCA+VLBA and VLBA-Only Images

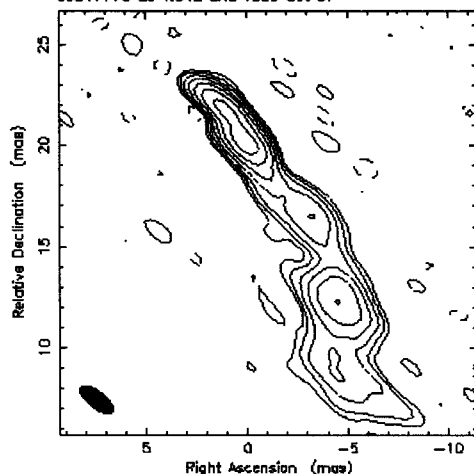
1.6 GHz

Clean map. Array: FHKLNPRMN
J0841+70 at 1.642 GHz 1999 Oct 07



Map center: RA: 08 41 24.365, Dec: +70 53 42.153 (2000.0)
Map peak: 0.808 Jy/beam
Contours: 1 2 4 8 16 32 64
Beam FWHM: 2.83 x 2.09 (mas) at 67.1°

Clean map. Array: FHKLNPRMN
J0841+70 at 1.642 GHz 1999 Oct 07

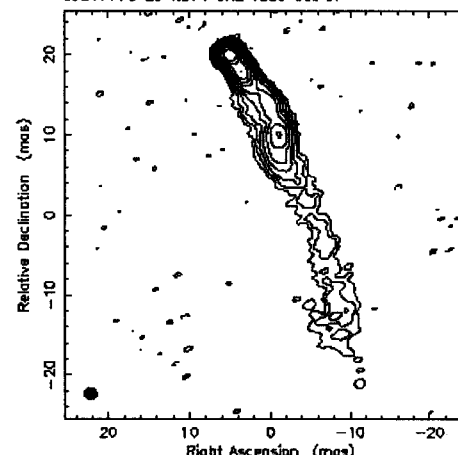


Map center: RA: 08 41 24.365, Dec: +70 53 42.153 (2000.0)
Map peak: 0.619 Jy/beam
Contours: 1 2 4 8 16 32 64
Beam FWHM: 1.83 x 0.813 (mas) at 51.7°

VLBA-only images

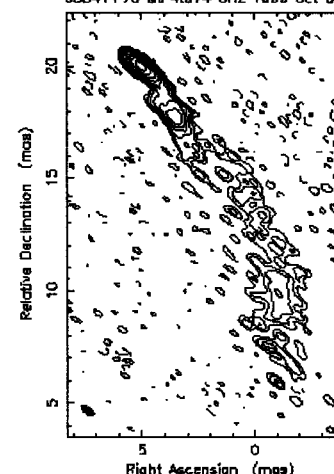
5 GHz

Clean map. Array: FHKLNPRMN
J0841+70 at 4.974 GHz 1999 Oct 07



Map center: RA: 08 41 24.364, Dec: +70 53 42.153 (2000.0)
Map peak: 1.21 Jy/beam
Contours: 1 2 4 8 16 32 64 128
Contours: 25.6 51.2
Beam FWHM: 1.51 x 1.35 (mas) at 73.1°

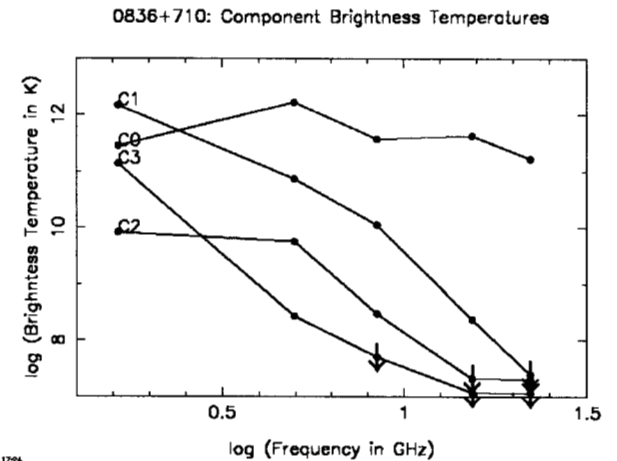
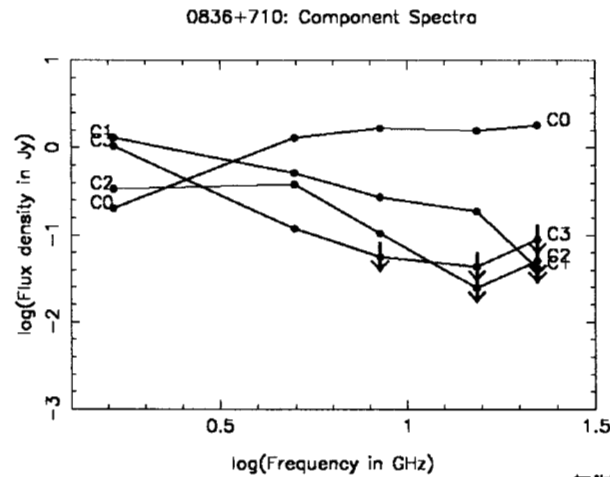
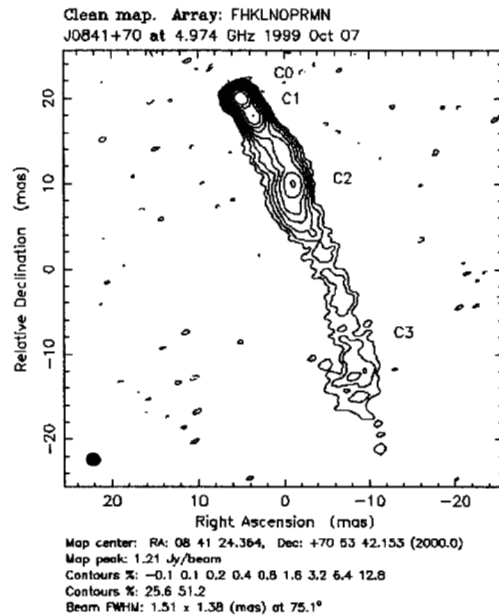
Clean map. Array: FHKLNPRMN
J0841+70 at 4.974 GHz 1999 Oct 07



Map center: RA: 08 41 24.364, Dec: +70 53 42.153 (2000.0)
Map peak: 0.817 Jy/beam
Contours: 1 2 4 8 16 32 64
Contours: 0.25 0.25 0.5 1 2 4 8 16 32 64
Beam FWHM: 0.853 x 0.274 (mas) at 51.6°

VLBA+HALCA images

Component Spectra and Brightness Temperatures



- Component definitions
- Core (C0) is inverted
- Jet components are steep spectrum
- Only Core (C0) and first jet component (C1) has brightness temperatures above the 10^{12} K IC limit

Conclusions

- Started a program to undertake coordinated Chandra and VSOP observations
- HALCA 1.6/5 GHz and VLBA-switching is a very efficient way to undertake SVLBI observations
- Small amount of extra VLBA time provides large increase in science return
- 0836+710: X-ray emission dominated by core and 2-mas component

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